TracVision® BY KVH INDUSTRIES

TracVision M5/M7
Switchplate Configuration

TracVision M5/M7 User's Guide

TracVision M5/M7

Switchplate Configuration User's Guide

This user's guide provides all of the basic information you need to operate, set up, and troubleshoot the TracVision M5/M7 satellite TV antenna system. For detailed installation information, please refer to the TracVision M5/M7 Installation Guide.

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If you have any comments regarding this manual, please e-mail them to manuals@kvh.com. Your input is greatly appreciated!

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1. Introduction

This chapter provides a basic overview of this manual and your TracVision system.

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1

Using this Manual

This manual provides complete operation, setup, and troubleshooting information for your TracVision system, as well as wiring diagrams for various TracVision M5/M7 system configurations.

Who Should Use This Manual

The **user** should refer to the "Operation" chapter to learn how to operate the system.

The **user**, **installer**, or **servicing technician** should refer to the "Settings" chapter for information on configuring the system and the "Wiring Diagrams" appendix for information on connecting additional receivers.

The **user** and/or **servicing technician** should refer to the "Troubleshooting" chapter to help identify the cause of a system problem.

Notifications Used in this Manual

This manual uses the following notifications to call attention to important information:

CAUTION

This is a danger, warning, or caution notice. Be sure to read these carefully to avoid injury!

IMPORTANT!

This is an important notice. Be sure to read these carefully to ensure proper operation and configuration of your TracVision system.

NOTE: *Notes contain useful information about system settings.*

TIP: *Tips contain helpful information, allowing you to get the most out of your TracVision system.*

Typographical Conventions

This manual uses the following typographical conventions:

Text Example	Description
HALT	Bold text in capital letters indicates a command to be entered via a PC
X	Bold text in *italicized* capital letters indicates a variable portion of a PC command

Related Documentation

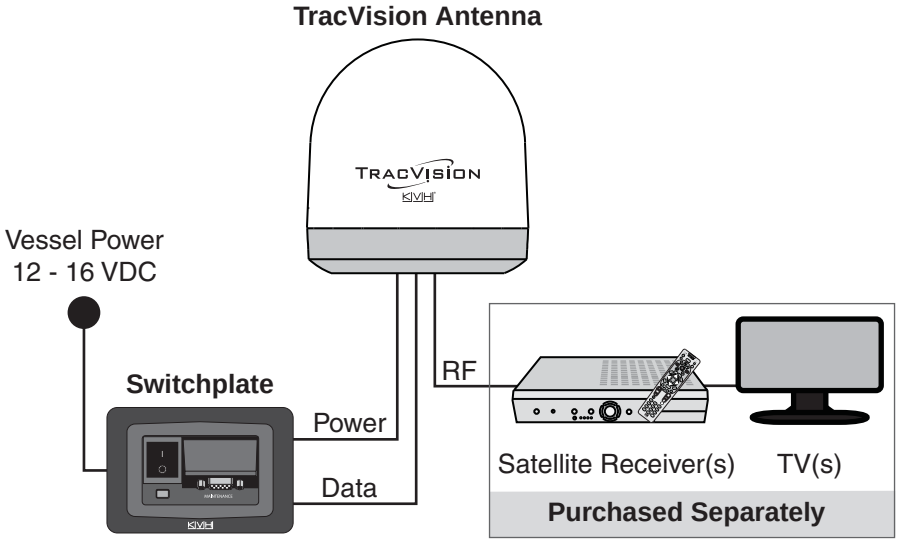
In addition to this User's Guide, the following documents are provided with your TracVision system:

Document	Description
Installation Guide	Complete product installation instructions
Product Registration Form	Details on registering the product
Warranty Statement	Warranty terms and conditions
Contents List	List of every part supplied in the kit

System Overview

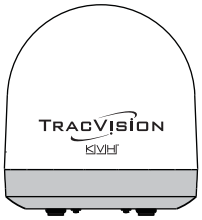
Your TracVision M5/M7 system is a state-of-the-art, actively stabilized antenna system that delivers live satellite TV to your vessel's audio/video entertainment system. A basic system is illustrated below.

Figure 1-1 TracVision System Diagram (Typical Installation)



TIP: *Receiver wiring diagrams are provided in Appendix A on page 63.*

Antenna Unit



The antenna unit houses the antenna positioning mechanism, LNB (low noise block), and control elements within a radome. Weathertight connectors join the power, signal, and control cabling from the belowdecks units.

Switchplate

The switchplate controls power to the antenna via the On/Off switch. The switchplate includes a maintenance port (DB9 connector), allowing you to connect a PC, an optional TV/SAT Switch, or a MultiSat Control Panel (MCP).

System Features

Your TracVision M5/M7 system uses integrated DVB technology to quickly acquire and track the correct satellite, switch between your selected satellites, and send TV signals to the receiver.

In-motion Tracking

The TracVision system includes a state-of-the-art actively stabilized antenna. Once the antenna acquires the satellite, its internal gyros continuously measure the heading, pitch, and roll of your vessel and send commands to the antenna motors, keeping the antenna pointed at the satellite at all times - even while you're on the move!

Satellite Tracking and Switching

Your TracVision M5/M7 system tracks your selected satellites as long as the vessel is located within the selected satellites' coverage area. During installation, your TracVision system should have been set up to track your desired satellites, allowing you to switch between them quickly and easily.

Satellite Library

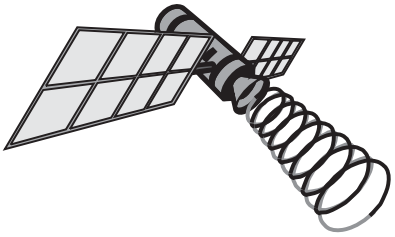
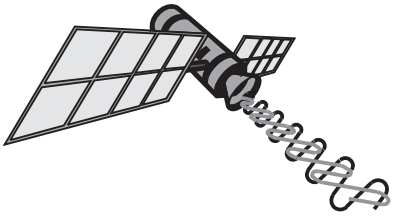
The TracVision M5/M7 system includes a pre-programmed library of the most popular satellites, offering a wide variety of satellite services to choose from. For complete information on the satellite library, see Chapter 3 "Settings" on page 25.

TIP: *Two more satellites of your choice can also be added to the satellite library. For complete information on adding satellites to the library, refer to the associated Application Note on the KVH Partner Portal (KVH-authorized technicians only).*

Circular and Linear Versions

Your TracVision system is configured for either circularly polarized satellite signals (e.g., North America) or linearly polarized satellite signals (e.g., Europe or Latin America). Figure 1-2 illustrates the difference between these two polarizations.

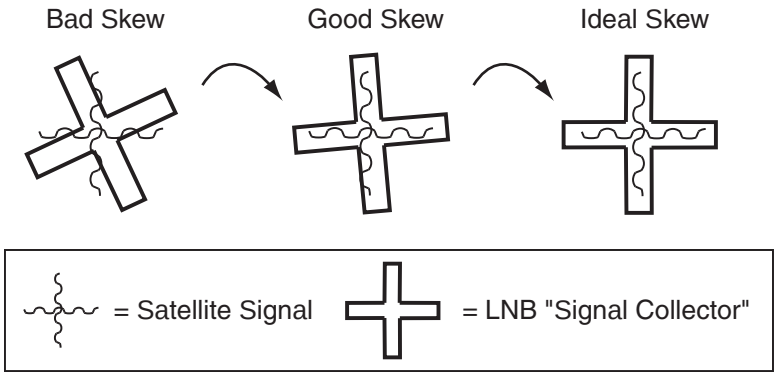
Figure 1-2 Polarizations of Satellite Signals

Circular	**Linear**
	
Signals transmitted in two "corkscrew" patterns, one running clockwise and one running counter-clockwise	Signals transmitted in vertical and horizontal "waves" offset exactly 90º from each other

LNB Skew Angle

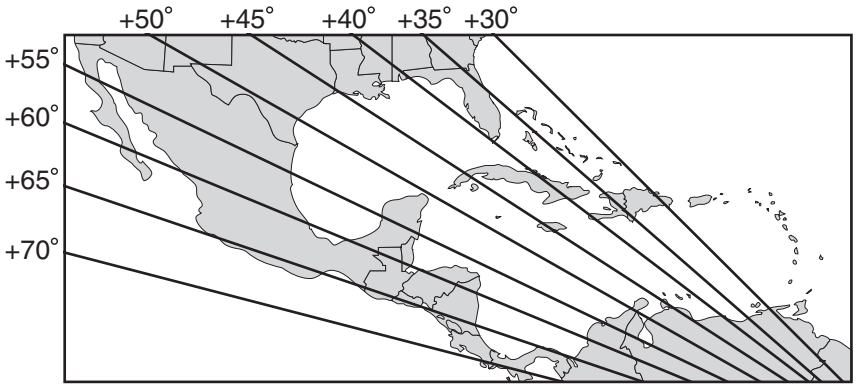
Since linear satellite signals are oriented in a precise cross pattern, the TracVision antenna's receiving element, called an LNB (low-noise block) must be oriented in the same way to optimize reception. This orientation adjustment is referred to as the LNB's "skew angle." Figure 1-3 illustrates how skew determines the amount of a linear signal the LNB collects. The more signal, the better the reception.

Figure 1-3 How Skew Works



The correct skew setting varies depending on your geographic location, since the orientation of your antenna to the satellite changes as you move. For example, if your antenna is tracking the PAS 9 satellite for Sky Mexico programming, the ideal skew setting ranges from +30 to +70, depending upon your location within the satellite's coverage area (see Figure 1-4).

Figure 1-4 Approximate Skew Settings for the PAS 9 Satellite



For complete details about adjusting the LNB's skew, see "Setting the LNB Skew Angle (Linear Versions)" on page 31.

2. Operation

This chapter explains everything you need to know to operate the TracVision system.

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Receiving Satellite TV Signals

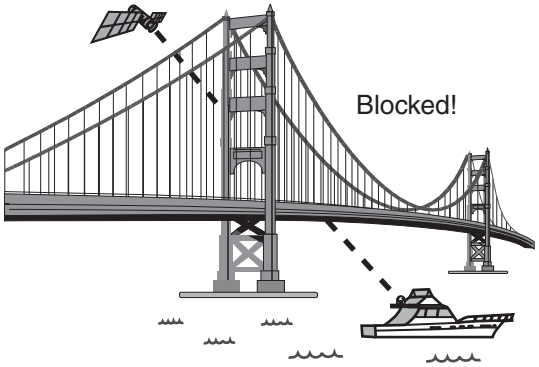
Television satellites are located in fixed positions above the Earth's equator and beam TV signals down to certain regions of the planet (not worldwide). To receive TV signals from a satellite, you must be located within that satellite's unique coverage area.

TIP: *For your convenience, KVH provides links to several websites that offer satellite coverage information. Simply visit our website at* ***www.kvh.com/footprint****.*

Figure 2-1 Location and Coverage Area of DIRECTV 101 Satellite

In addition, since TV satellites are located above the equator, the TracVision antenna must have a clear view of the sky to receive satellite TV signals. Anything that stands between the antenna and the satellite can block the signal, resulting in lost reception. Common causes of blockage include boat masts, trees, buildings, and bridges. Heavy rain, ice, or snow might also temporarily interrupt satellite signals.

Figure 2-2 Example of Satellite Blockage



Turning the System On/Off

You can turn the system on or off using the switchplate.

Turning On the System

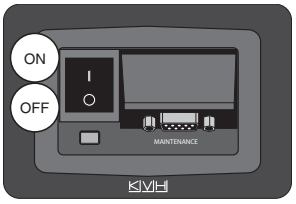
Follow the steps below to turn on your TracVision system.

IMPORTANT!

Avoid turning the vessel or changing TV channels for one minute after turning on the system.

1. Make sure the antenna has a clear view of the sky.
2. Turn on your satellite TV receiver and TV.
3. Set the switchplate's Power switch to the On (|) position.

Figure 2-3 Switchplate Power Switch



4. Wait one minute for system startup.

Turning Off the System

Follow the steps below to turn off your TracVision system.

1. Set the switchplate's Power switch to the Off (O) position.
2. Turn off your satellite TV receiver and TV.

Changing Channels and Switching Between Satellites (Circular Versions)

During installation, your TracVision system should have been set up to track the satellite(s) of your choice and the channel guide for your selected satellite service should have been downloaded.

Since some channels might be located on another satellite, changing channels might require switching between satellites. With most TracVision configurations, satellite switching occurs automatically while you change channels using the primary receiver's remote control. Find your selected service and configuration in the following sections for complete details.

NOTE: *The primary receiver is the receiver connected to the antenna's RF1 connector.*

DISH 1000 (Required for TurboHD Service)

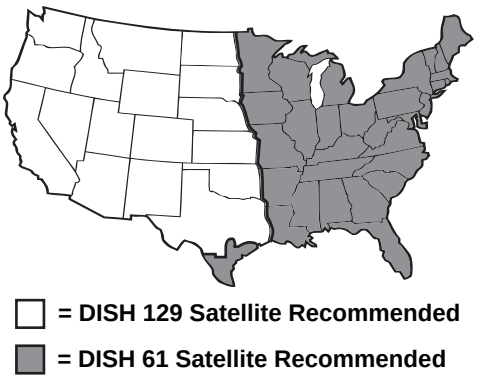
When the TracVision M5/M7 system is configured for DISH 1000, you can view the DISH HDTV programming for your geographic area. The system can be set to either DISH 1000/61 mode or DISH 1000/129 mode.

Figure 2-4 DISH 1000 Configurations

Configuration	Satellites Tracked
DISH 1000/61	DISH 110, 119, and 61
DISH 1000/129	DISH 110, 119, and 129

During installation, your TracVision system should have been set to the DISH 1000 configuration that best suits your geographic location (see Figure 2-5) and local channels requirements. If you change satellite coverage areas, refer to "DISH 1000 Setup" on page 38 to change your DISH 1000 configuration.

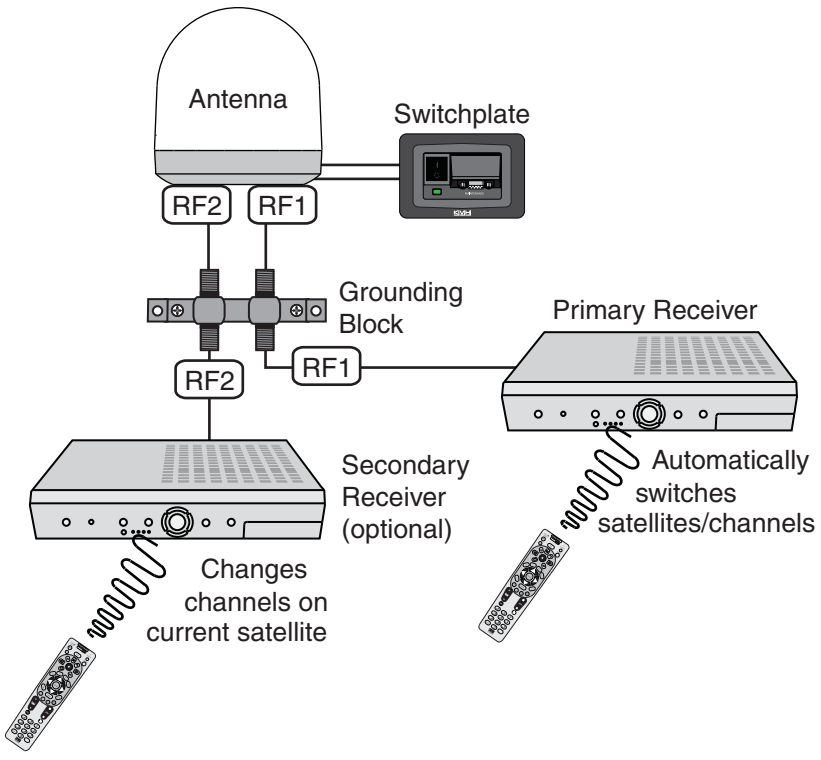
Figure 2-5 Regional DISH 1000 Configuration Recommendations



DISH 1000 Automatic Mode - Preferred for One or Two Receivers

The antenna switches between satellites automatically as you change channels using the primary receiver's remote control. The primary receiver is the receiver connected to the antenna's RF1 cable (see Figure 2-6). If an optional secondary receiver is connected, you can use its remote control to switch between the channels on the currently selected satellite.

Figure 2-6 DISH 1000 Primary Receiver/Secondary Receiver Controls

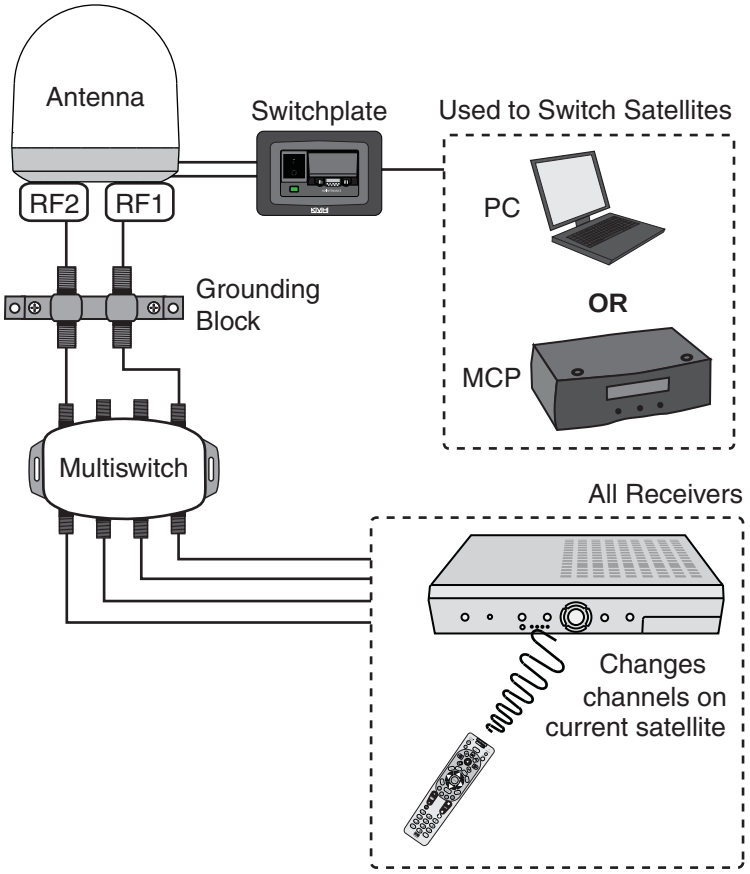


DISH 1000 Manual Mode - Required for Three or More Receivers

Since multiswitches interfere with communications between the receivers and the antenna, the system must be set up in Manual mode when three or more receivers are installed. When manual mode is enabled, you can switch between your selected satellites using a PC or an optional MultiSat Control Panel (MCP) (KVH Part #01-0260-02). You can use the receivers' remote controls to switch between the channels on the currently selected satellite.

NOTE: *Refer to "Switching Between Installed Satellites Using a PC" on page 51 for more information on using a PC.*

Figure 2-7 DISH 1000 Manual Mode - Receiver/PC/MCP Controls



Dual-Sat Mode - DISH 500, ExpressVu, DIRECTV, and Custom Service Configurations

Several service configurations require Dual-Sat mode operation. Figure 2-8 lists each Dual-Sat service configuration, the satellites tracked for each service, and the available satellite switching modes.

Figure 2-8 Dual-Sat Modes

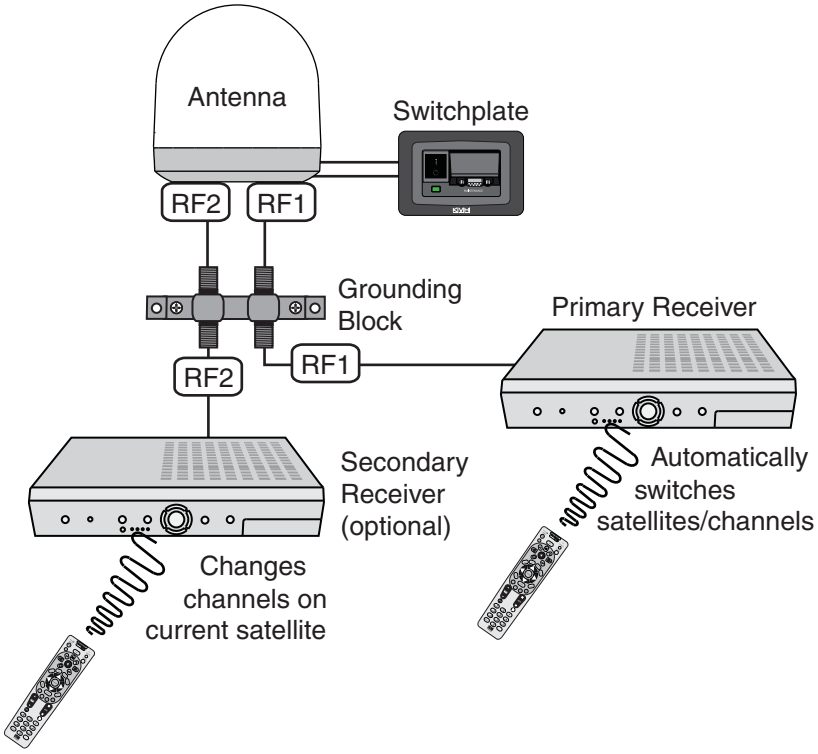
Service	Satellites Tracked	Switching Mode(s)
DIRECTV	DIRECTV 101 and 119	Auto or Manual
DISH 500	DISH 119 and 110	Auto or Manual
ExpressVu	ExpressVu 91 and 82	Auto or Manual
Custom	Selected by user	Manual

Dual-Sat Automatic Mode - Preferred for One or Two Receivers*

The antenna switches between satellites automatically as you change channels using the primary receiver's remote control. The primary receiver is the receiver connected to the antenna's RF1 cable (see Figure 2-9). If an optional secondary receiver is connected, you can use its remote control to switch between the channels on the currently selected satellite.

***NOTE:** Custom service configurations must use Manual mode.*

Figure 2-9 Dual-Sat Automatic Mode - Receiver Controls

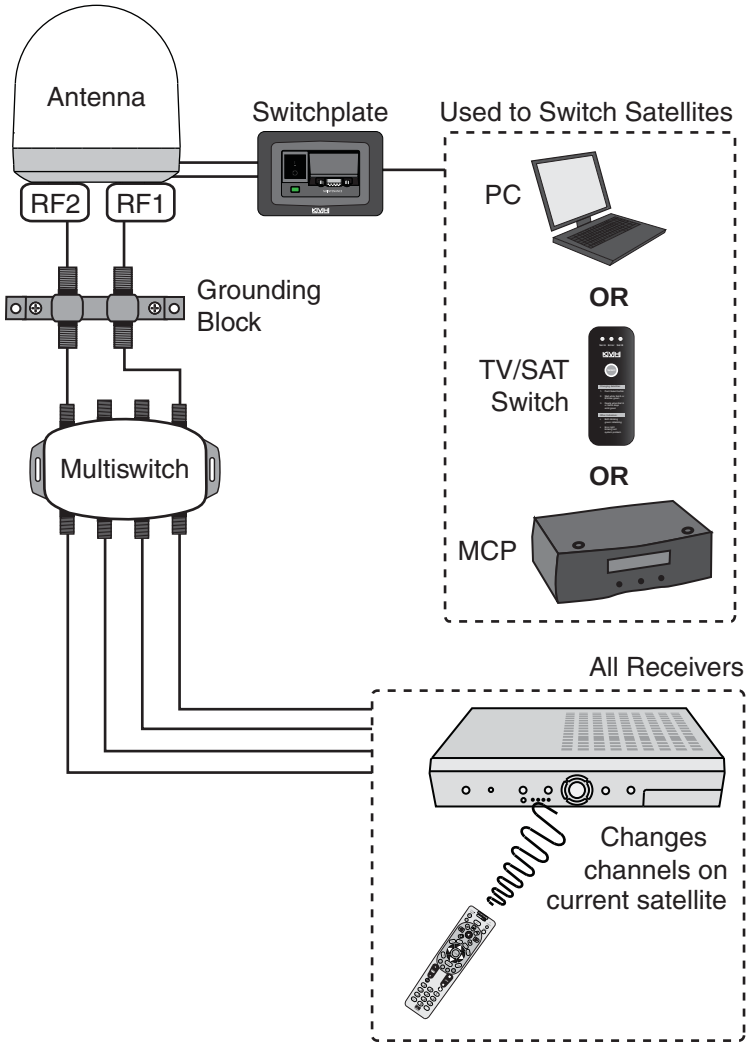


Dual-Sat Manual Mode - Required for Three or More Receivers and All Custom Service Configurations

Circular TracVision M5/M7 systems with three or more receivers require the use of a multiswitch. Since multiswitches interfere with satellite switching communications between the receivers and the antenna, the system must be set up in Manual mode. When manual mode is enabled, you can switch between your selected satellites using a PC, an optional TV/SAT Switch (KVH Part #01-0245), or an optional MultiSat Control Panel (MCP) (KVH Part #01-0260-02). You can use the receivers' remote controls to switch between the channels on the currently selected satellite.

NOTE: *Refer to "Switching Between Installed Satellites Using a PC" on page 51 for more information on using a PC.*

Figure 2-10 Dual-Sat Manual Mode - Receiver/PC/TV/SAT Switch/MCP Controls



Changing Channels and Switching Between Satellites (Linear Versions)

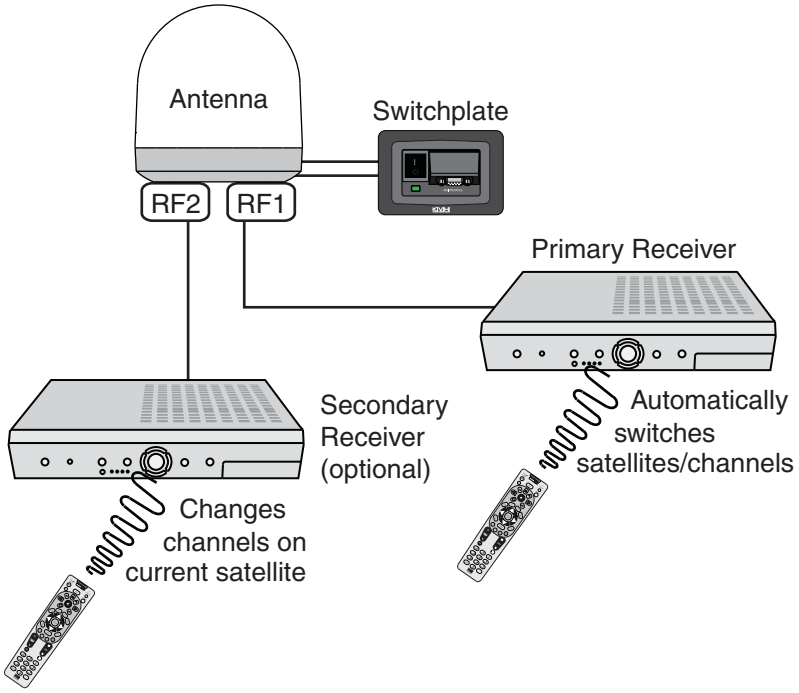
Since some channels might be located on another satellite, changing channels might require switching between satellites. Switching between satellites occurs automatically with most TracVision system configurations. However, if the TracVision system includes a multiswitch, manual satellite switching is required.

Automatic Satellite Switching

The TracVision system can switch between satellites automatically as long as the primary receiver is set up for DiSEqC communicatons and a multiswitch is not installed. With DiSEqC set up, the primary receiver sends satellite switching commands to the antenna as necessary when you change channels using the primary receiver's remote control. The primary receiver is the receiver connected to the antenna's RF1 cable (see Figure 2-11).

NOTE: *To enable automatic switching, the receiver must be properly configured for DiSEqC (see "Linear Receiver Configuration" on page 22 for more information).*

Figure 2-11 Primary/Secondary Receiver Control (Dual-output version shown)



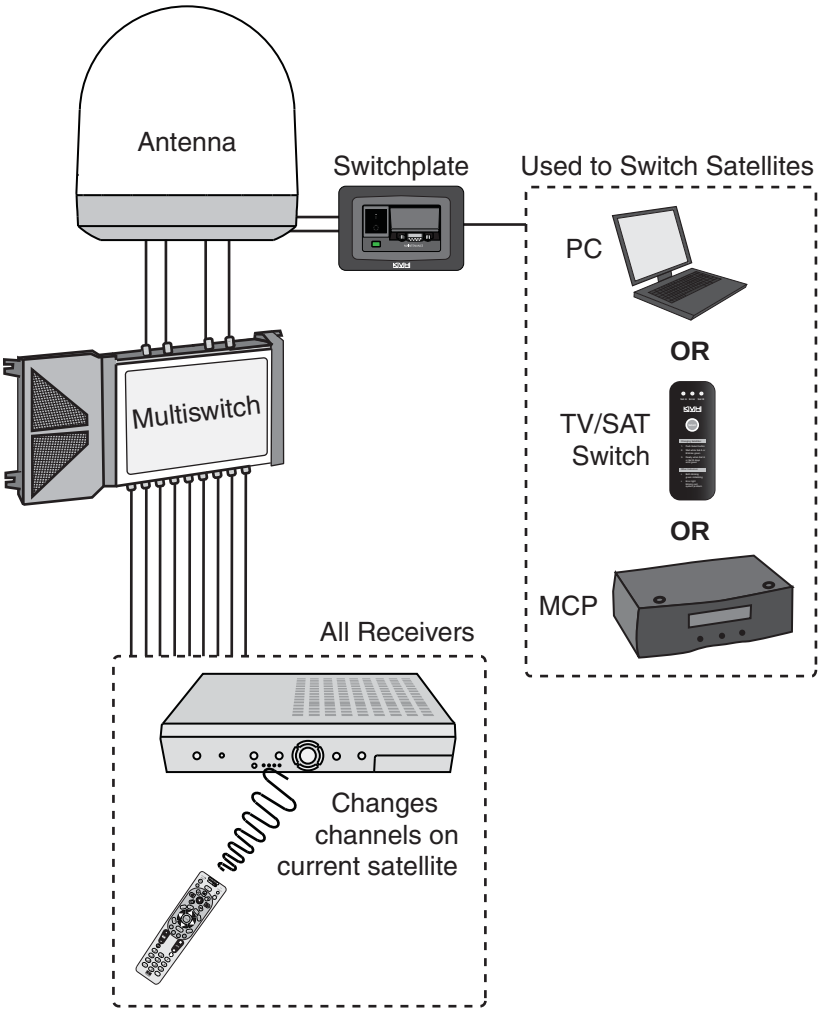
Manual Satellite Switching - Multiswitch Installations

If the TracVision system includes a multiswitch, you can use the receivers' remote controls to change between the channels on the currently selected satellite. You will need to use a PC, a TV/SAT Switch* (KVH Part #01-0245), or an optional MultiSat Control Panel (MCP) (KVH Part #01-0260-02) to switch between your selected satellites.

***NOTE:** Does not support European Tri-Sat configurations.*

***NOTE:** Refer to "Switching Between Installed Satellites Using a PC" on page 51 for more information on using a PC.*

Figure 2-12 Manual Mode - Receiver/PC/TV/SAT Switch/MCP Controls (Quad-output version shown)



Receiver Requirements

This section explains receiver setup requirements and lists the U.S. and Canadian receiver models that are validated for use with the TracVision M5/M7 system.

Circular Receiver Compatibility

To ensure compatibility with your TracVision M5/M7 system, be sure to use a KVH-validated receiver for your selected service type (see Figure 2-13).

Figure 2-13 KVH-Validated U.S. and Canadian Receivers

Standard-definition receivers		
DIRECTV	**DISH**	**ExpressVu**
D12 D11 D10	311	3100 4100
High-definition receivers		
DIRECTV	**DISH**	**ExpressVu**
HD not supported	211k 211	6100

NOTE: *For information on connecting different receiver models, please contact KVH Technical Support at 1-401-847-3327.*

DISH Network/ExpressVu Receiver Configuration

If your TracVision M5/M7 system is set up for DISH Network or ExpressVu service, your receiver(s) should have been configured during installation. In most cases, you do not need to reconfigure your receiver(s). However, Figure 2-14 lists special scenarios that require DISH Network/ExpressVu receiver configuration.

Figure 2-14 Receiver Configuration Requirements

Receiver Configuration is Required When...
• **DISH 1000 only -** You change satellite coverage areas (see Figure 2-5 on page 14)
• You add a receiver
• You have reconfigured a receiver for home use

If you need to configure a receiver(s) for DISH Network/ExpressVu use, follow the instructions for configuring the receiver for your selected service type in Chapter 3 "Settings" on page 25.

Linear Receiver Configuration

If the TracVision system does not include a multiswitch, you can configure the receiver(s) to enable automatic satellite switching. TracVision systems with a multiswitch installed require switching satellites using the MCP, which does not require receiver configuration.

To configure the receivers for automatic switching, the satellites must be set up in the receiver in the same order they were set up in the TracVision system (see Figure 2-15).

Figure 2-15 Antenna/Receiver Synchronization Settings

TracVision Satellite	**Receiver Satellite**	**DiSEqC Setting**
Satellite A	Alternative 1 or A	DiSEqC 1
Satellite B	Alternative 2 or B	DiSEqC 2
Satellite C*	Alternative 3 or C	DiSEqC 3

***NOTE:** Only European Tri-Sat configurations track three satellites.*

Product Care

Please consider the following antenna care guidelines for maintaining peak performance:

- Periodically wash the exterior of the antenna dome with fresh water and mild detergent. Avoid harsh cleansers and volatile solvents (such as acetone) and do not spray the dome directly with high-pressure water.

- If you wish to paint the dome, use only non-metallic automotive paint without a primer coat. Any paint that contains metal will block satellite signals and impair reception.

3. Settings

This chapter contains information on system settings and how to modify them.

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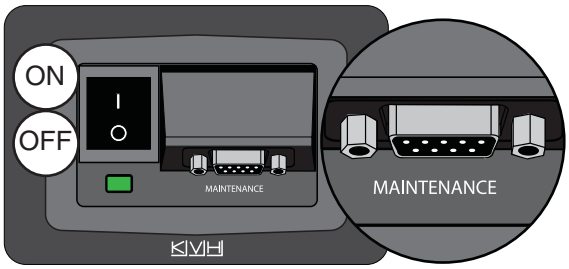
Connecting a PC to the Maintenance Port

In order to modify system settings, you first need to connect a PC to the TracVision M5/M7 system. This procedure requires a PC with Windows HyperTerminal (or equivalent) and a serial data cable.

TIP: *If you are a KVH-authorized technician, you can use the KVH Flash Update Wizard instead of HyperTerminal. Enter commands in the Wizard's "Antenna Comms" window. You do not need to flash the antenna to enter commands.*

1. Set the switchplate's power switch to the Off (O) position.

Figure 3-1 Switchplate Power Switch and Maintenance Port



2. Connect a serial data cable from the maintenance port (DB9 connector) located on the switchplate to the serial port on your PC.

TIP: *If your computer does not have a DB9 serial COM port, you can use the following USB-to-RS232 adapters: IO Gear Part # GUC232A (visit* ***www.iogear.com****), Belkin Part # F5U109, or Belkin Part # F5U409 (visit* ***www.belkin.com****).*

3. Open HyperTerminal and establish the following settings:

   - Bits per second: 9600
   - Data bits: 8
   - Parity: None
   - Stop Bits:1
   - Flow Control: None

Figure 3-2 HyperTerminal Settings

TIP: *To view characters on the screen as you type, set up HyperTerminal to echo typed characters. Select "Properties" from the File menu; select "ASCII Setup" at the Settings tab; then select "Echo typed characters locally" at the ASCII Setup window.*

4. Set the switchplate's power switch to the On (|) position (see Figure 3-1 on page 27). Wait one minute for system startup.

NOTE: *If antenna startup data does not start scrolling in the HyperTerminal window, check the back of the switchplate to ensure nothing is plugged into the rear DB9 connector.*

Setting Sleep Mode

When the vessel has come to a stop and holds its position for one minute (e.g., at a dock), the antenna unit enters Sleep Mode, which locks the antenna in place to conserve power. As soon as the vessel moves beyond a 1° - 2° window or the signal level changes significantly, Sleep Mode automatically turns off and the system begins tracking the satellite again (or enters Search Mode to find the satellite).

Follow the instructions below if you wish to change the Sleep Mode setting.

NOTE: *Sleep Mode is enabled by default.*

1. Connect a PC to the maintenance port, as described in "Connecting a PC to the Maintenance Port" on page 27. Then type the following commands in the HyperTerminal window.
2. Type **HALT** then press Enter.
3. Type **DEBUGON** then press Enter.
4. Type the desired command below to modify the Sleep Mode setting then press Enter.

Desired Sleep Setting	Type
Disabled	**SLEEPOFF**
Enabled	**SLEEPON**

5. Type **ZAP** then press Enter to restart the antenna. Wait one minute for system startup.

Setting Latitude and Longitude

When the TracVision system's latitude and longitude data is current, the time spent acquiring a satellite is minimized. Follow the instructions below if you wish to set your vessel's latitude and longitude data.

TIP: *For your convenience, you can determine your approximate latitude and longitude using the Position Grids provided in Appendix B on page 69.*

1. Connect a PC to the maintenance port, as described in "Connecting a PC to the Maintenance Port" on page 27. Then type the following commands in the HyperTerminal window.

2. Type **HALT** then press Enter.

3. Type the following **GPS** command then press Enter.

   GPS,*XX*,*D*,*YYY*,*Z*

Field	Description
XX	Your latitude (0-90)
D	S (South) or N (North)
YYY	Your longitude (0-180)
Z	E (East) or W (West)

4. Type **ZAP** then press Enter to restart the antenna. Wait one minute for the system startup.

Setting the LNB Skew Angle (Linear Versions)

To optimize satellite signal reception, linear TracVision M5/M7 systems require adjusting the skew angle of the antenna's LNB (low-noise block) whenever you change your geographic location or change which satellites are set up for tracking. Before setting the skew angle, be sure to determine the correct skew angle for your selected satellite(s).

TIP: *Sky Mexico subscribers can also refer to Figure 1-4 on page 8 for the approximate skew setting for the PAS-9 satellite.*

Determining the Skew Angle

Follow the steps below to determine the skew angle for the selected satellite(s).

1. Connect a PC to the maintenance port, as described in "Connecting a PC to the Maintenance Port" on page 27. Then type the following commands in the HyperTerminal window.

2. Type **HALT** then press Enter.

3. Type **DEBUGON** then press Enter.

4. Enter the vessel's latitude and longitude into the antenna using the **GPS** command, as explained in "Setting Latitude and Longitude" on page 30.

5. Type **SKEWANGLE** then press Enter. The skew for the selected satellite is displayed. Write down the skew value for later use.

Adjusting the Skew Angle

Once you have determined the proper skew angle, follow the steps below to adjust the antenna's LNB skew angle.

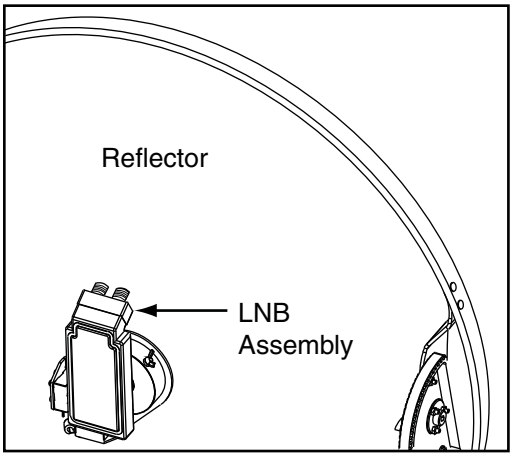
⚠ CAUTION
To avoid bodily injury, be sure to turn off the antenna and disconnect power to all wired components.

1. Turn off the antenna and disconnect power to all wired components, including receivers.

2. Using a Phillips-head screwdriver, remove the screws securing the radome. Then remove the radome and set it aside in a safe place.

3. Locate the LNB assembly on the back of the antenna reflector.

Figure 3-3 Location of LNB on Back of Antenna Reflector



4. Using a 2 mm allen hex key, loosen the two M4 socket set screws securing the LNB. The location of the screws varies according to TracVision model; refer to Figure 3-4 or Figure 3-5.

Figure 3-4 TracVision M5 Set Screws

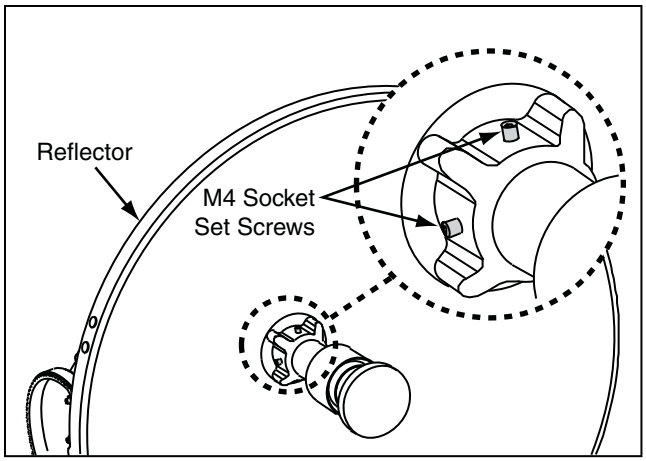
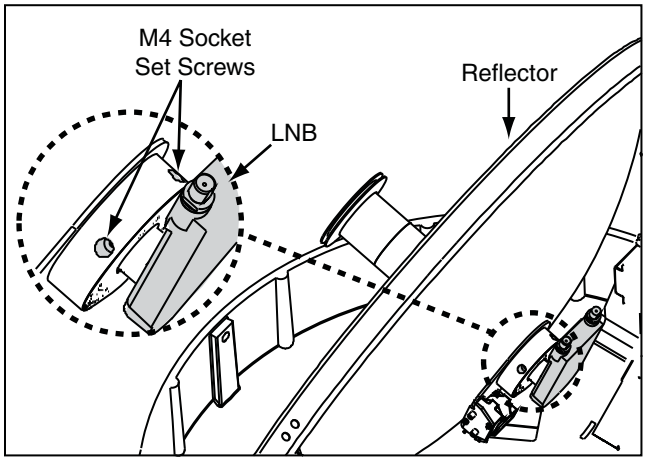


Figure 3-5 TracVision M7 Set Screws

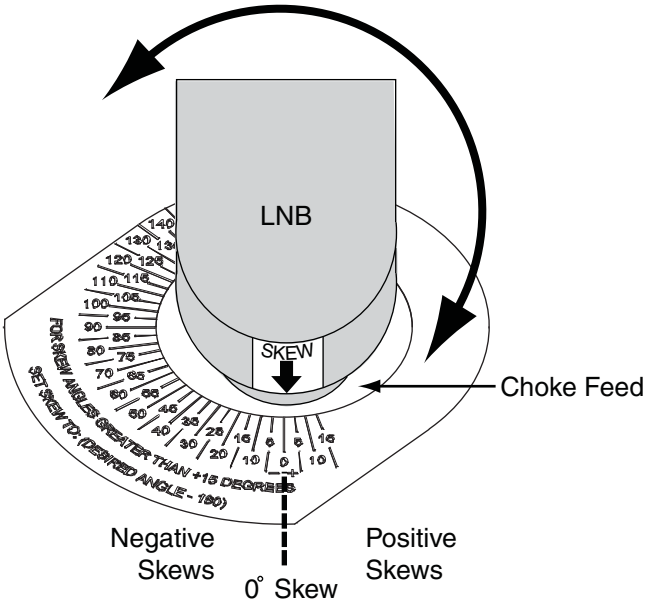


5a. TracVision M5 Only - Adjust the LNB clockwise or counter-clockwise, until the skew arrow on the LNB points to the skew angle that you determined earlier. Due to label constraints, if the skew angle is greater than +15°, you need to subtract 180 to get the equivalent negative skew angle and set the LNB to that angle instead. For example, if the skew angle is determined to be +30°, set the skew to -150°.

IMPORTANT!

Be sure to keep the LNB fully inserted into the choke feed to ensure optimum performance.

Figure 3-6 TracVision M5 LNB Skew Angle Adjustment

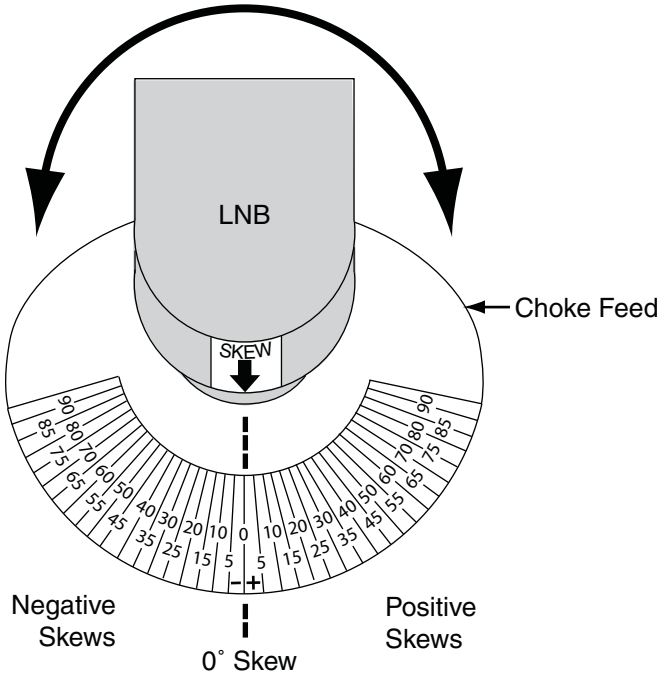


5b. TracVision M7 Only - Adjust the LNB clockwise or counter-clockwise, until the skew arrow on the LNB points to the skew angle that you determined earlier.

IMPORTANT!

Be sure to keep the LNB fully inserted into the choke feed to ensure optimum performance.

Figure 3-7 TracVision M7 LNB Skew Angle Adjustment



6. Tighten the two M4 socket set screws to secure the LNB in place. Apply 9 in-lbs (1 Nm) of torque, if possible.

7. Reinstall the radome.

8. Restore power to the TracVision system.

NOTE: *For more information about how skew works, see "LNB Skew Angle" on page 7.*

Determining Which Satellites are Configured for Tracking

Figure 3-8 lists the satellites configured for tracking in common configurations and the satellite positions in the TracVision system (Satellite A, B, or C).

Figure 3-8 Satellites/Satellite Positions for Common Configurations

Configuration	Installation Names/Positions		
	Satellite A	**Satellite B**	**Satellite C**
DISH 1000/61	ECHO_119	ECHO_110	ECHO_61
DISH 1000/129	ECHO_119	ECHO_110	ECHO_129
DISH 500	ECHO_119	ECHO_110	-
DIRECTV Dual-Sat	DSS_101	DSS_119	-
ExpressVu	EXPRESSTV	EXPRESSVU	-
Sky Mexico	PAS_9	NONE*	-
Europe WB Tri-Sat	HOTBIRDWB	ASTRA1	ASTRA2S
Europe Tri-Sat	HOTBIRD	ASTRA1	ASTRA2S
Europe Scandinavian Tri-Sat	HOTBIRDWB	SIRIUS	THOR
Custom	Selected by User	Selected by User	-

***NOTE:** Since all Sky Mexico programming is located on the Pas-9 satellite, Sky Mexico configurations use "NONE" as the name of Satellite B.*

Follow the steps below if you wish to check which satellites the TracVision system is configured to track. An example is shown in Figure 3-9.

1. Connect a PC to the maintenance port, as described in "Connecting a PC to the Maintenance Port" on page 27. Then type the following commands in the HyperTerminal window.

2. Type **HALT** then press Enter.

3. Type **SATINSTALL** then press Enter.

4. The satellites currently configured for tracking are displayed. Type **ZAP** then press Enter to restart the antenna. Wait one minute for system startup.

Figure 3-9 Example, DISH 1000/61 Mode Displayed

HALT
SATINSTALL
ECHO_119,ECHO_110,ECHO_61
ZAP

NOTE: *Displayed results for DISH 1000 Tri-Sat configurations display the individual satellites configured for tracking, not the "trisat" commands used during installation.*

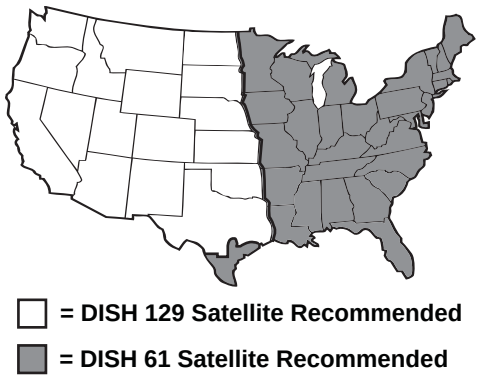
TIP: *The order the satellites are reported in reflects their configured position in the TracVision system. For example, in Figure 3-9, ECHO_119 is in the "Satellite A" position, ECHO_110 is in the "Satellite B" position, and ECHO_61 is in the "Satellite C" position.*

DISH 1000 Setup

This section explains how to configure the TracVision system for DISH 1000 use, which is required for TurboHD service. This section also explains how to switch between DISH 1000/61 and DISH 1000/129 configurations, which might be required when switching between DISH 1000 satellite coverage areas (see Figure 3-10).

TIP: *For additional DISH 1000 information, refer to "DISH 1000 (Required for TurboHD Service)" on page 13.*

Figure 3-10 Approximate DISH 1000 Satellite Coverage Areas



DISH 1000/129 Setup

Follow the steps below to set up the TracVision system for DISH 1000/129 use.

Install the DISH 1000/129 Satellites Via a PC

1. Connect a PC to the maintenance port, as described in "Connecting a PC to the Maintenance Port" on page 27. Then type the following commands in the HyperTerminal window.

2. Type **HALT** then press Enter.

3. Type **SATINSTALL,TRISAT,DISH** then press Enter.

4. Enter the vessel's latitude and longitude into the antenna using the **GPS** command, as explained in "Setting Latitude and Longitude" on page 30.

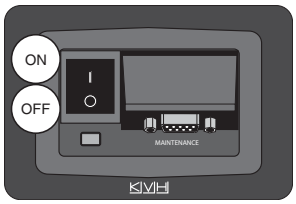
5. Type **ZAP** then press Enter to restart the antenna. Wait one minute for system startup.

Configure the Receiver(s)

NOTE: *If you are connecting multiple receivers, repeat this process for each additional receiver. You will need to connect each receiver, one at a time, to the RF1 cable and perform the steps below. Then, once you have completed this process for each receiver, you can reconnect them as desired.*

1. Dock the vessel in a blockage-free area.
2. Ensure the receiver you wish to configure is connected to the TracVision system's RF1 cable.
3. Turn on the TV and receiver.
4. Set the switchplate's power switch to the On (|) position to apply power to the TracVision antenna. Wait one minute for system startup.

Figure 3-11 Switchplate Power Switch



5. Using the receiver's remote, go to the "Point Dish / Signal Strength" screen (press MENU, 6, 1, 1 on most models).
6. Choose **Check Switch**, then press SELECT.
7. Choose **Test**, then press SELECT.
8. Wait at least 15 minutes before proceeding. Disregard messages on the TV stating the test is complete; you must wait 15 minutes before proceeding.

IMPORTANT!

Please be patient. The Check Switch test takes approximately 15 minutes to complete. Disregard any messages on the TV stating the test is complete; the antenna must perform additional operations before proceeding.

9. After waiting 15 minutes, repeat Steps 5-7 to run a second Check Switch test.

10. Verify the values on your TV match those required for DISH 1000/129 mode (see Figure 3-12). If your values do not match, turn off the antenna, then turn it back on and repeat Steps 5-9.

Figure 3-12 DISH 1000/129 Second Check Switch Results on TV Screen

Port	1	2	3
Satellite	119	110	129
Trans	OK	OK	OK
Status	Reception Verified		
Switch	SW64		

11. Exit the menu and allow the receiver to download the program guide.

NOTE: *You do not need to perform this procedure again unless you add another receiver, you reconfigured a receiver(s) for home use, or you move to a different DISH 1000 satellite coverage area (see Figure 3-10 on page 38).*

DISH 1000/61 Setup

The following instructions explain how to configure the TracVision system for DISH 1000/61 use.

Install the DISH 1000/61 Satellites Via a PC (if required)

If your TracVision system is currently configured for DISH 1000/129 and you wish to configure DISH 1000/61 instead, follow the steps below to install the DISH 1000/61 satellites via a PC. If your TracVision system is *not* currently configured for DISH 1000/129, skip to "Configure the Receiver(s)" on page 41.

1. Connect a PC to the maintenance port, as described in "Connecting a PC to the Maintenance Port" on page 27. Then type the following commands in the HyperTerminal window.

2. Type **HALT** then press Enter.

3. Type **SATINSTALL,TRISAT,DISH61** then press Enter.

4. Enter the vessel's latitude and longitude into the antenna using the **GPS** command, as explained in "Setting Latitude and Longitude" on page 30.

5. Type **ZAP** then press Enter to restart the antenna. Wait one minute for system startup.

Configure the Receiver(s)

NOTE: *If you are connecting multiple receivers, repeat this process for each additional receiver. You will need to connect each receiver, one at a time, to the RF1 cable and perform the steps below. Then, once you have completed this process for each receiver, you can reconnect them as desired.*

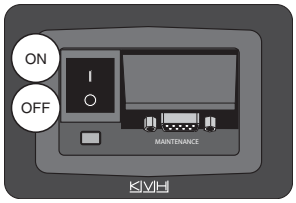
1. Dock the vessel in a blockage-free area.

2. Ensure the receiver you wish to configure is connected to the TracVision system's RF1 cable.

3. Turn on the TV and receiver.

4. Set the switchplate's power switch to the On (|) position to apply power to the TracVision antenna. Wait one minute for system startup.

Figure 3-13 Switchplate Power Switch



5. Using the receiver's remote, go to the "Point Dish / Signal Strength" screen (press MENU, 6, 1, 1 on most models).

6. Choose **Check Switch**, then press SELECT.

7. Choose **Test**, then press SELECT.

8. Wait at least 15 minutes before proceeding. Disregard messages on the TV stating the test is complete; you must wait 15 minutes before proceeding.

IMPORTANT!

Please be patient. The Check Switch test takes approximately 15 minutes to complete. Disregard any messages on the TV stating the test is complete; the antenna must perform additional operations before proceeding.

9. After waiting 15 minutes, repeat Steps 5-7 to run a second Check Switch test.

10. Verify the values on your TV match those required for DISH 1000/61 mode (see Figure 3-14). If your values do not match, turn off the antenna, then turn it back on and repeat Steps 5-9.

Figure 3-14 DISH 1000/61 Results on TV Screen

Port	1	2	3
Satellite	119	110	61
Trans	OK	OK	OK
Status	Reception Verified		
Switch	SW64		

11. Exit the menu and allow the receiver to download the program guide.

NOTE: *You do not need to perform this procedure again unless you add another receiver, you reconfigured a receiver(s) for home use, or you move to a different DISH 1000 satellite coverage area (see Figure 3-10 on page 38).*

DISH 500/ExpressVu Setup

This section explains how to configure the TracVision system for DISH 500 or ExpressVu service.

Install Satellites Via a PC

1. Connect a PC to the maintenance port, as described in "Connecting a PC to the Maintenance Port" on page 27. Then type the following commands in the HyperTerminal window.

2. Type **HALT** then press Enter.

3. Type the appropriate **SATINSTALL** command from the table below, then press Enter.

To Configure:	**Type:**
DISH 500 (tracks 119 and 110)	**SATINSTALL,ECHO_119,ECHO_110**
ExpressVu (tracks 91 and 82)	**SATINSTALL,EXPRESSTV,EXPRESSVU**

NOTE: *If you only wish to track one of the satellites listed above, type "NONE" to substitute the second satellite. For example, ExpressVu subscribers who wish to track just the 91 satellite should type "SATINSTALL,EXPRESSTV,NONE"*

4. Enter the vessel's latitude and longitude into the antenna using the **GPS** command, as explained in "Setting Latitude and Longitude" on page 30.

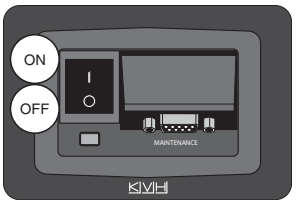
5. Type **ZAP** then press Enter to restart the antenna. Wait one minute for system startup.

Configure the Receiver(s)

NOTE: *If you are connecting multiple receivers, repeat this process for each additional receiver. You will need to connect each receiver, one at a time, to the RF1 cable and perform the steps below. Then, once you have completed this process for each receiver, you can reconnect them as desired.*

1. Stop the vessel in a blockage-free area.
2. Ensure the receiver you wish to configure is connected to the TracVision system's RF1 cable.
3. Turn on the TV and receiver.
4. Set the switchplate's power switch to the On (|) position to apply power to the TracVision antenna. Wait one minute for system startup.

   Figure 3-15 Switchplate Power Switch

5. Using the receiver's remote, go to the "Point Dish / Signal Strength" screen (press MENU, 6, 1, 1 on most models).
6. Choose **Check Switch**, then press SELECT.
7. Choose **Test**, then press SELECT.
8. Wait at least 15 minutes before proceeding. Disregard messages on the TV stating the test is complete; you must wait 15 minutes before proceeding.

IMPORTANT!

Please be patient. The Check Switch test takes approximately 15 minutes to complete. Disregard any messages on the TV stating the test is complete; the antenna must perform additional operations before proceeding.

9. After waiting 15 minutes, repeat Steps 5-7 to run a second Check Switch test.

10. Verify the values on your TV match those required for selected service (see Figure 3-16 or Figure 3-17). If your values do not match, turn off the antenna, then turn it back on and repeat Steps 5-9.

NOTE: *If you chose to install only one satellite in Step 3 on page 43, an error message will appear on the TV. This is normal.*

Figure 3-16 DISH 500 Second Check Switch Results on TV Screen

Port	1	1	2	2
Satellite	119	119	110	110
Trans	Odd	Even	Odd	Even
Status	Reception Verified			
Switch	SW42			

Figure 3-17 ExpressVu Second Check Switch Results on TV Screen

Port	1	1	2	2
Satellite	91	91	82	82
Trans	Odd	Even	Odd	Even
Status	Reception Verified			
Switch	SW21			

11. Exit the menu and allow the receiver to download the program guide.

NOTE: *You do not need to perform this procedure again unless you add another receiver or you reconfigured a receiver(s) for home use.*

European Tri-Sat Setup

This section explains how to configure the TracVision system to track three satellites within pre-defined linear satellite groups for use in European locations (see Figure 3-18). For operation instructions, refer to "Changing Channels and Switching Between Satellites (Linear Versions)" on page 19.

Figure 3-18 European Tri-Sat Groups

Group Name	Satellites Included
Europe WB	Hotbird WB Astra 1 Astra 2S
Europe	Hotbird Astra 1 Astra 2S
Scandinavia	Hotbird WB Sirius Thor

NOTE: *Be sure to record the skew angle (the average skew for all three satellites) reported during this procedure. You will need this information if you need to adjust the TracVision system's skew angle. See "Setting the LNB Skew Angle (Linear Versions)" on page 31 for more information on setting the skew angle.*

NOTE: *To enable automatic switching, the receiver must be set up to match the TracVision system's satellite settings. Refer to "Linear Receiver Configuration" on page 22 for more information.*

1. Connect a PC to the maintenance port, as described in "Connecting a PC to the Maintenance Port" on page 27. Then type the following commands in the HyperTerminal window.

2. Type **HALT** then press Enter.

3. Use the table below to enter the following **SATINSTALL** command.

For Group	Type
Europe WB	**SATINSTALL,TRISAT,EWB**
Europe	**SATINSTALL,TRISAT,EUR**
Scandinavia	**SATINSTALL,TRISAT,SCN**

4. Type **ZAP** then press Enter to restart the antenna. Wait one minute for system startup.

Configuring the Antenna to Track Different Satellites

You can change which satellites your TracVision M5/M7 system tracks by choosing up to two satellites from either the circular satellite library (see Figure 3-19) or the linear satellite library (see Figure 3-20 on page 49). This procedure requires a PC with Windows HyperTerminal (or equivalent) and a serial data cable.

NOTE: *The entire circular satellite library is listed in Figure 3-19 for reference purposes. However, if you are a DISH Network or ExpressVu subscriber, refer to "DISH 1000 Setup" on page 38 or "DISH 500/ExpressVu Setup" on page 43 for complete configuration instructions. For European Tri-Sat setups, refer to "European Tri-Sat Setup" on page 46.*

TIP: *Be sure to only install satellites that your TracVision M5/M7 can track in your geographic location. For your convenience, KVH provides links to several websites that offer satellite coverage information. Simply visit our website at* ***www.kvh.com/footprint****.*

Figure 3-19 Circular Satellite Library

Satellite Service	Satellite Location	Installation Name
AsiaSat 4	122.2° E	ASIASAT*****
DIRECTV	72.0° W	DSS_72
	101.0° W	DSS_101
	110.0° W	DSS_110*****
	119.0° W	DSS_119
DIRECTV Latin America	95.0° W	GALAXY3CN*****
DISH Network	61.5° W	ECHO_61
	110.0° W	ECHO_110
	119.0° W	ECHO_119
	129.0° W	ECHO_129
ExpressVu	82.0° W	EXPRESSVU
	91.0° W	EXPRESSTV

****NOTE:*** *Reception of these satellites requires additional hardware. Please contact your local KVH-authorized dealer/distributor or KVH Technical Support for details.*

Figure 3-20 Linear Satellite Library

Satellite Location	Installation Name
26.0° E	ARABSAT
19.2° E	ASTRA1
28.2° E	ASTRA2N
28.2° E	ASTRA2S
7.0° E	EUTEL_W3A
30.0° W	HISPASAT
13.0° E	HOTBIRD
13.0° E	HOTBIRDWB
7.0° W	NILESAT
160.0° E	OPTUSD1*
156.0° E	OPTUSC1
58.0°W	PAS_9
110.5° E	SINOSAT*
5.0° E	SIRIUS
0.8° W	THOR
42.0° E	TURKSAT1C

***NOTE:** Reception of these satellites requires additional hardware. Please contact your local KVH-authorized dealer/distributor or KVH Technical Support for details.*

IMPORTANT!

Linear Systems Only - For optimal performance, you might need to adjust the skew angle if you change satellites. For information on setting the skew angle, see "Setting the LNB Skew Angle (Linear Versions)" on page 31.

Configure the New Satellites to Be Tracked

The following instructions explain how to set up the TracVision system to track your selected satellites. An example is provided in Figure 3-21.

NOTE: DISH Network/ExpressVu subscribers - *Refer to "DISH 1000 Setup" on page 38 or "DISH 500/ExpressVu Setup" on page 43 instead, for instructions specific to your selected configuration type.*

1. Connect a PC to the maintenance port, as described in "Connecting a PC to the Maintenance Port" on page 27. Then type the following commands in the HyperTerminal window.

2. Type **HALT** then press Enter.

3. Type the following **SATINSTALL** command then press Enter.

   SATINSTALL,*X*,*Y*

Field	Description
X	The installation name of your choice for Satellite A
Y	The installation name of your choice for Satellite B

4. Type **ZAP** then press Enter to restart the antenna. Wait one minute for system startup

Figure 3-21 Example, Eutelsat W3A and Hotbird

```
HALT
SATINSTALL,EUTELW3A,HOTBIRD
ZAP
```

NOTE: Linear Versions Only - *To ensure proper operation, the satellites must be set up in the receiver in the same order they were set up in the TracVision system (see "Linear Receiver Configuration" on page 22 for more information).*

Switching Between Installed Satellites Using a PC

Follow the instructions below if you wish to use a PC to switch between your installed satellites.

NOTE: *Linear versions with receivers synchronized for use with the TracVision system will need to restart the antenna after performing this procedure to resume receiver-controlled satellite switching.*

1. Connect a PC to the maintenance port, as described in "Connecting a PC to the Maintenance Port" on page 27. Then type the following commands in the HyperTerminal window.

2. Type the appropriate command below to switch to your desired satellite then press Enter.

To Switch To	Type
Satellite A	**@L,A**
Satellite B	**@L,B**
Satellite C*	**@L,C**

***DISH 1000 and European Tri-Sat setups only.*

TIP: *To determine which satellites are installed, and in which satellite position (A, B, or C), refer to "Determining Which Satellites are Configured for Tracking" on page 36.*

4. Troubleshooting

This chapter identifies potential basic problems along with their possible causes and solutions. It also explains how to get technical support.

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Troubleshooting Matrix..... 56
Causes and Remedies for Operational Issues 57
Technical Support..... 61

4

Five Simple Checks

If you are experiencing a problem receiving satellite TV with your TracVision system, perform the five simple checks below.

TIP: *You can also try resetting the satellite TV receiver. Turn off and unplug the receiver, wait one minute, then plug it back in and turn it back on.*

Can the antenna see the satellite?

The antenna requires an unobstructed view of the sky to receive satellite TV signals. Common causes of blockage include trees, buildings, bridges, and mountains.

Is there excessive dirt or moisture on the antenna dome?

Dirt buildup or moisture on the dome can reduce satellite reception. Clean the exterior of the dome periodically.

Is it raining heavily?

Heavy rain or snow can weaken satellite TV signals. Reception should improve once the inclement weather subsides.

Is everything turned on and connected properly?

Make sure your TV and receiver are both turned on and set up for the satellite input. Finally, check any connecting cables to ensure none have come loose.

(Linear Versions Only) Is the antenna's LNB set to the correct skew angle?

To optimize reception, the antenna's LNB needs to be set to the correct skew angle for the satellite(s) you want to track. See "Setting the LNB Skew Angle (Linear Versions)" on page 31 for details.

Troubleshooting Matrix

The troubleshooting matrix in Figure 4-1 identifies potential operational symptoms and their causes and remedies. "Causes and Remedies for Operational Issues" on page 57 contains detailed information on the causes and remedies listed below.

Figure 4-1 Troubleshooting Matrix

SYMPTOM / CAUSES AND REMEDIES	Receiver fault or improper receiver configuration	Satellite coverage issue	Satellite signal blocked	Radar interference	Satellite frequency data changed	Vessel turning during startup	Insufficient power	Improper wiring	Loose RF connectors	Type of multiswitch used	Cable unwrap
Antenna non-functional							x	x			
Antenna not switching satellites	x	x	x				x	x	x	x	
No picture on TV set	x	x	x	x	x			x	x	x	
Certain channels do not work	x	x	x		x		x	x	x		
Intermittent picture for short intervals		x	x	x		x			x	x	x
System works at dock but not on the move			x			x					
System will not find satellite	x	x	x	x	x	x	x	x	x	x	
Snowy television picture	x						x	x	x		
Pixelating television picture	x	x	x	x		x	x	x	x		

Causes and Remedies for Operational Issues

This section addresses the most common operational issues that can affect the performance of the TracVision M5/M7 system. If your TracVision system requires service, you can visit any KVH-authorized dealer or distributor for assistance. To find a KVH-authorized dealer near you, visit ***www.kvh.com/wheretogetservice***.

Receiver Fault or Improper Receiver Configuration

Receiver Fault

Your satellite TV receiver might be set up incorrectly or defective. First check the receiver's configuration to ensure it is set up for the desired programming. In the case of a faulty receiver, refer to your selected receiver's user manual for service and warranty information.

(Linear Versions Only) Improper Receiver Configuration

To ensure proper operation, the receiver(s) must be set up for the same satellites, and in the same order, they are set up in the antenna:

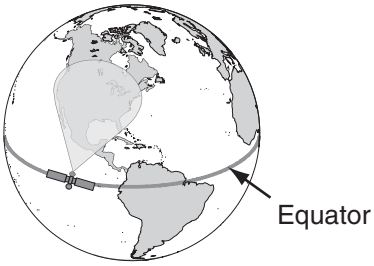
TracVision Satellite	Receiver Satellite	DiSEqC Setting
Satellite A	Alternative 1 or A	DiSEqC 1
Satellite B	Alternative 2 or B	DiSEqC 2
Satellite C	Alternative 3 or C	DiSEqC 3

Satellite Coverage Issue

Television satellites are located in fixed positions above the Earth's equator and beam TV signals down to certain regions of the planet (not worldwide). To receive TV signals from a satellite, you must be located within that satellite's unique coverage area.

TIP: *For your convenience, KVH provides links to several websites that offer satellite coverage information. Simply visit our website at* ***www.kvh.com/footprint****.*

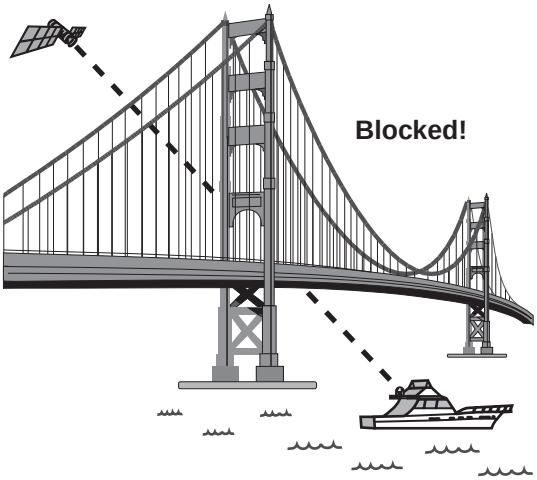
Figure 4-2 Location and Coverage Area of DIRECTV 101 Satellite



Satellite Signal Blocked

Since TV satellites are located above the equator, the TracVision antenna must have a clear view of the sky to receive satellite TV signals. Anything that stands between the antenna and the satellite can block the signal, resulting in lost reception. Common causes of blockage include boat masts, trees, buildings, and bridges. Heavy rain, ice, or snow might also temporarily interrupt satellite signals.

Figure 4-3 Example of Satellite Blockage



Radar Interference

The TracVision M5/M7 antenna must be kept out of line with nearby radars, as their energy levels might overload the antenna's front-end circuits. Refer to the TracVision M5/M7 Installation Guide for details or visit any KVH-authorized dealer or distributor for assistance. To find a KVH-authorized dealer near you, visit ***www.kvh.com/wheretogetservice***.

Satellite Frequency Data Changed

If some channels work, while one or more other channels do not, or if the antenna cannot find the selected satellite, the satellite's frequency data might have changed. You can visit any KVH-authorized dealer or distributor for assistance. To find a KVH-authorized dealer near you, visit ***www.kvh.com/wheretogetservice***.

Vessel Turning During Startup

If you turned the vessel during the first minute after startup, the gyro calibration that occurs during startup might be invalid, which might cause the TracVision M5/M7 system to track improperly. To solve this problem, simply turn off the TracVision M5/M7 system for at least ten seconds. Then turn on the TracVision system, ensuring the vessel is either motionless or traveling in a straight line for the first minute after startup.

Insufficient Power

If the power cable to the antenna unit is more than 50 ft (15 m) long, the power level can decrease over the course of the cable, resulting in a voltage level at the antenna that is too low to power the system. Refer to the TracVision M5/M7 Installation Guide for details on supplying adequate power to the antenna or visit any KVH-authorized dealer or distributor for assistance. To find a KVH-authorized dealer near you, visit ***www.kvh.com/wheretogetservice***.

Improper Wiring

If the system has been improperly wired, the antenna will not operate correctly. Refer to the TracVision M5/M7 Installation Guide for complete system wiring information or visit any KVH-authorized dealer or distributor for assistance. To find a KVH-authorized dealer near you, visit ***www.kvh.com/wheretogetservice***.

Loose RF Connectors

KVH recommends periodically checking the system's cable connections. A loose RF connector can reduce signal quality or prevent automatic satellite switching using the receiver's remote control. Refer to the TracVision M5/M7 Installation Guide for complete system wiring information or visit any KVH-authorized dealer or distributor for assistance. To find a KVH-authorized dealer near you, visit ***www.kvh.com/wheretogetservice***.

Type of Multiswitch Used

If your TracVision system's configuration requires a multiswitch, an active (powered) multiswitch must be used to ensure proper antenna performance. Refer to the Wiring Diagrams in Appendix A on page 63 for detailed information and recommended multiswitch models.

Cable Unwrap

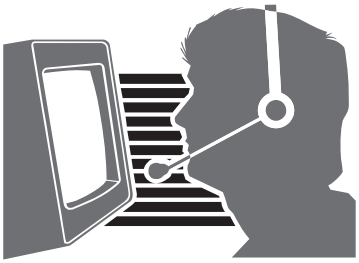
If your vessel makes several consecutive circles in the same direction, the antenna will rotate 720° before reaching the end of its internal cable. If this occurs, the system will automatically unwrap the cable by quickly rotating the antenna dish in the opposite direction. During this time, your TV picture will freeze momentarily.

Technical Support

The TracVision M5/M7 antenna is a sophisticated electronic device. KVH-authorized technicians have the specialized tools and expertise necessary to diagnose and repair a system fault. Therefore, if you experience any operating problem or require technical assistance, please call or visit your local authorized TracVision dealer or distributor. To find a KVH-authorized dealer near you, visit ***www.kvh.com/wheretogetservice***.

If you need help finding an authorized technician, please contact KVH Technical Support:

North/South America, Australia:
Phone: +1 401 847-3327
E-mail: techs@kvh.com
(Mon.-Fri., 9 am-6 pm ET, -5 GMT)
(Sat., 9 am-2 pm ET, -5 GMT)



Europe, Middle East, Asia:
Phone: +45 45 160 180
E-mail: support@kvh.dk
(Mon.-Fri., 8 am-4:30 pm, +1 GMT)

Please have your antenna serial number handy before you call.

Appendix A
Wiring Diagrams

This appendix provides receiver wiring diagrams for basic configurations. Wiring diagrams vary according to the number of receivers installed and the TracVision system configuration (circular/linear and dual/quad-output). For installation instructions, refer to the TracVision M5/M7 Installation Guide.

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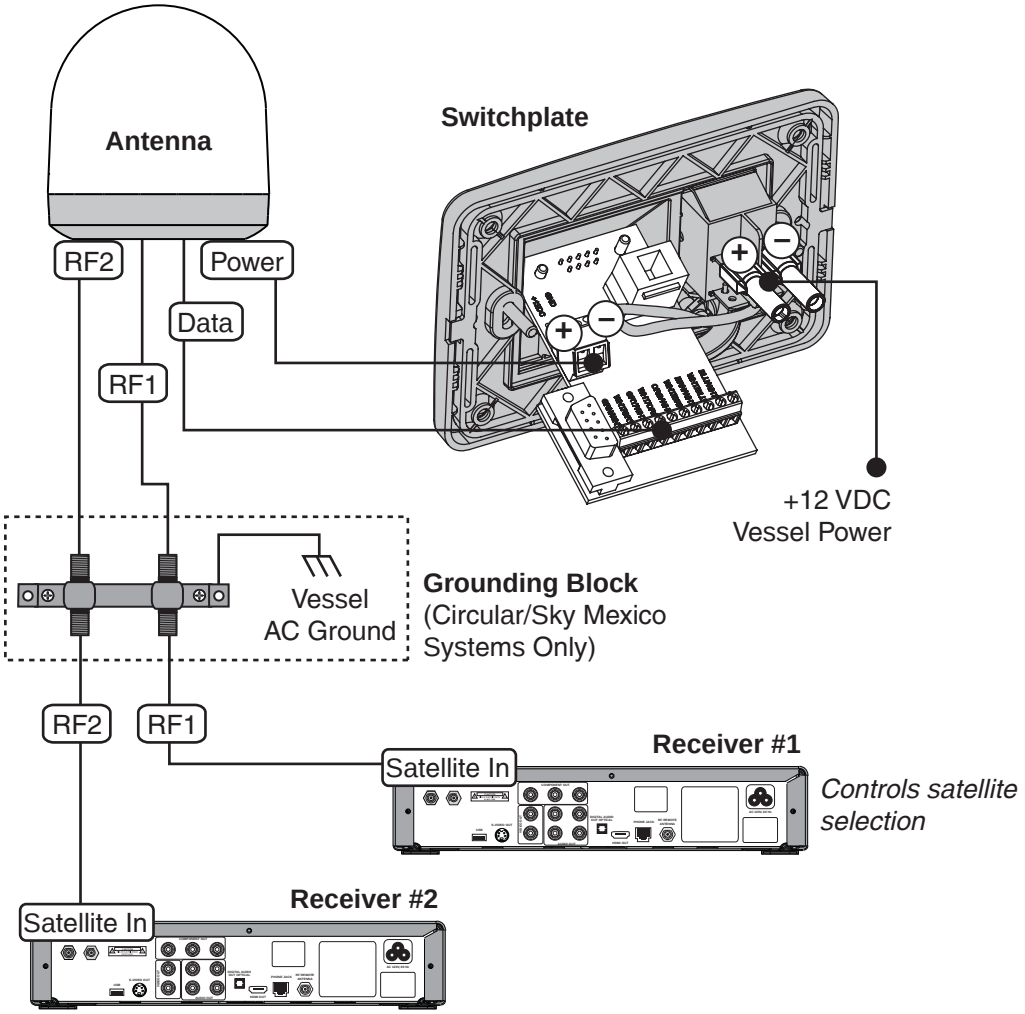
Wiring Diagram for One or Two Receivers 65

Wiring Diagram for Three or Four Receivers (Circular Version) 66

Wiring Diagram for Three or Four Receivers (Linear Quad-output LNB Version) 67

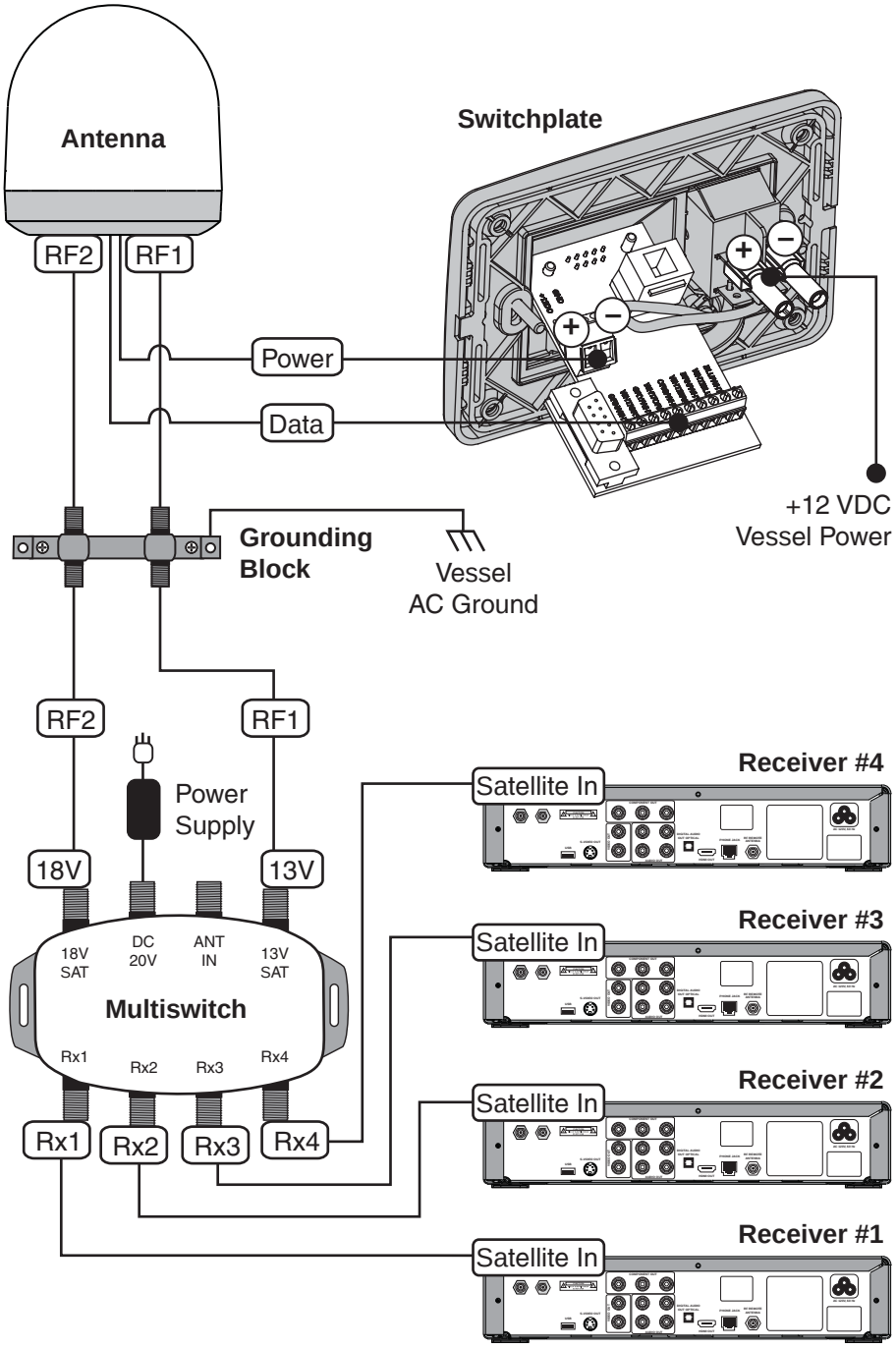
A

Wiring Diagram for One or Two Receivers



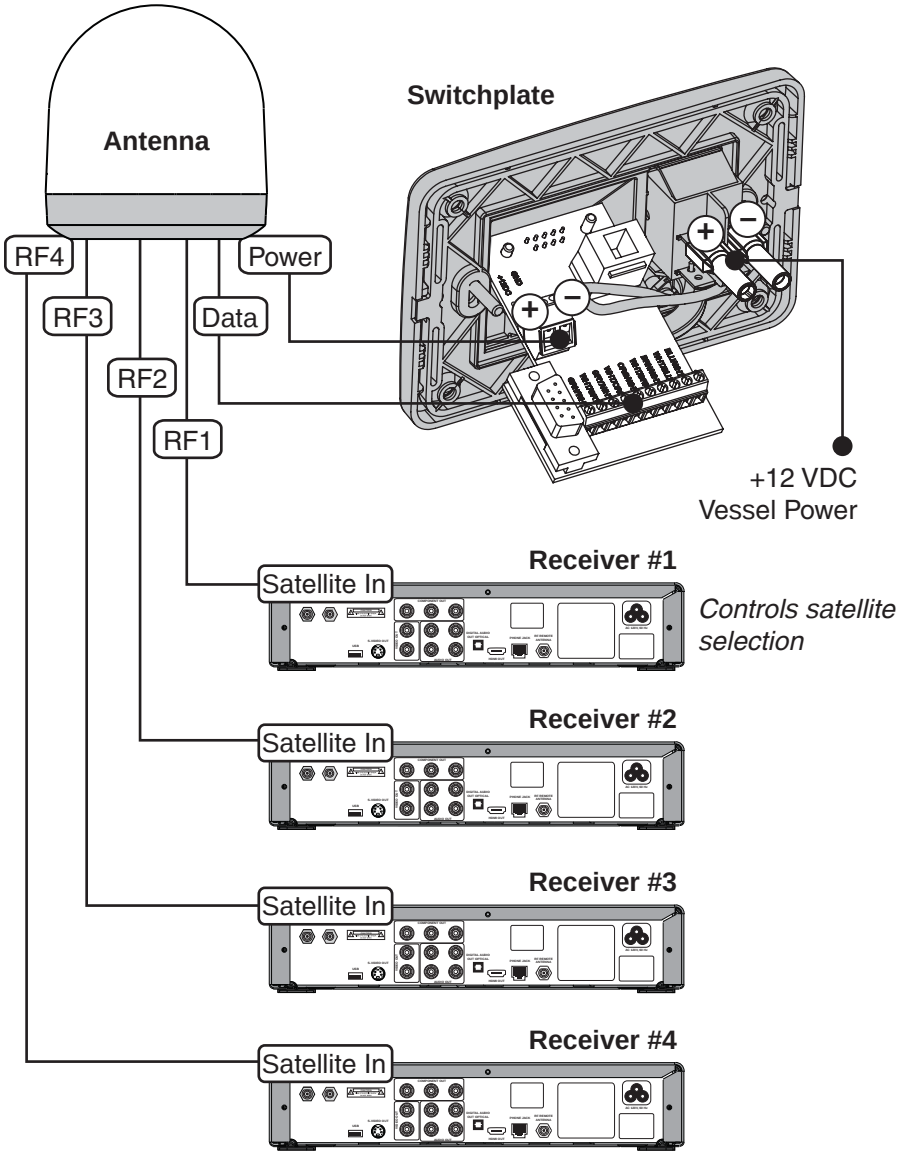
Circular Version Only

Wiring Diagram for Three or Four Receivers (Circular Version)*



***NOTE:** This configuration does not support automatic satellite switching. This configuration requires an Eagle Aspen multiswitch (KVH Part #72-0310). This configuration also requires a PC, an optional TV/SAT Switch (KVH Part #01-0245), or a MultiSat Control Panel (MCP) (KVH Part #01-0260-02) to manually switch between satellites.*

Wiring Diagram for Three or Four Receivers (Linear Quad-Output LNB Version)*



***NOTE:** If you wish to connect more than four receivers, you will need to install an active (powered) multiswitch, such as Spaun model SMS5602 NF (KVH Part #19-0413). Multiswitch configurations require the use of either a PC, an optional TV/SAT Switch (KVH Part #01-0245), or a MultiSat Control Panel (MCP) (KVH Part #01-0260-02) to switch between satellites.*

Appendix B
Position Grids

This appendix contains European and North American position grids for determining your approximate latitude and longitude.

Contents

European Position Grid 71

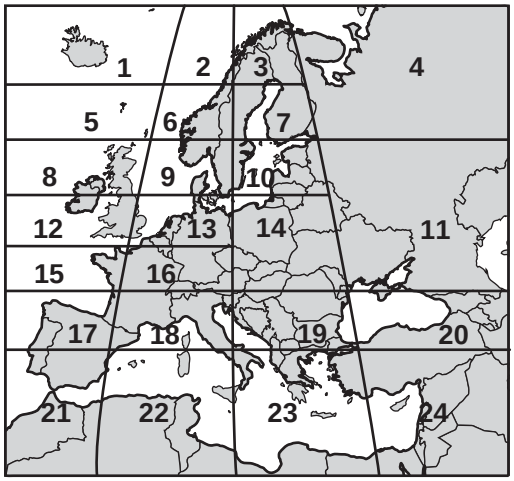
North American Position Grid 72

B

European Position Grid

If you wish to determine your approximate latitude and longitude, use the position grid and table in Figure B-1.

Figure B-1 Approximate Latitude and Longitude

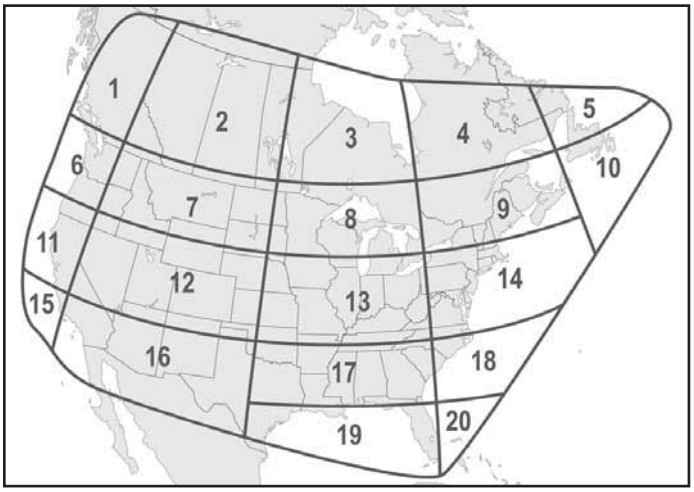


Grid #	Latitude	Longitude
1	67° N	7° W
2	67° N	7° E
3	67° N	22° E
4	65° N	45° E
5	63° N	7° W
6	63° N	7° E
7	63° N	22° E
8	57° N	7° W
9	57° N	7° E
10	57° N	22° E
11	55° N	40° E
12	53° N	7° W
13	53° N	7° E
14	50° N	22° E
15	47° N	7° W
16	47° N	7° E
17	43° N	7° W
18	43° N	7° E
19	43° N	22° E
20	43° N	37° E
21	36° N	7° W
22	36° N	7° E
23	36° N	22° E
24	36° N	37° E

North American Position Grid

If you wish to determine your approximate latitude and longitude, use the position grid and table in Figure B-2.

Figure B-2 Approximate Latitude and Longitude



Grid #	Latitude	Longitude
1	55° N	125° W
2	55° N	110° W
3	55° N	90° W
4	55° N	70° W
5	55° N	55° W
6	45° N	125° W
7	45° N	110° W
8	45° N	90° W
9	45° N	70° W
10	45° N	50° W
11	40° N	125° W
12	40° N	110° W
13	40° N	90° W
14	40° N	70° W
15	32° N	125° W
16	32° N	110° W
17	32° N	90° W
18	32° N	75° W
19	27° N	83° W
20	27° N	78° W

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